

Little is known of the identity and physiological effects of the organic matter given off in the process of respiration. The former belief that the discomfort experienced in confined spaces was due to some toxic volatile matter in the expired air is now limited, in the light of numerous researches, to the much less dogmatic view that the presence of such a substance has not been demonstrated. The only certain fact is that expired and transpired air may be odorous and offensive, and it is capable of producing loss of appetite and a disinclination for physical activity. These reasons, whether esthetic or physiological, call for the introduction of a certain minimum amount of clean outdoor air to dilute the odoriferous matter to a concentration which is not objectionable.

In certain industrial processes toxic fumes and gases may be produced, whose removal by local exhaust ventilation is essential for the protection of human health; and in the ordinary occupied space chemical impurities may be contributed by the fumes from certain types of cooking and heating appliances. Odors of cooking should not be minimized since it has been shown that odors have an important indirect effect on health in diminishing the appetite for food; and carbon monoxide from imperfect combustion may be a serious hazard to life and health.

When the only source of contamination is the human occupant, the minimum quantity of outdoor air needed appears to be that necessary to remove objectionable body odors, or tobacco smoke. The concentration of body odor in a room, in turn, depends upon a number of factors, including socio-economic status of occupants, outdoor air supply, air space allowed per person, odor adsorbing capacity of air conditioning processes, temperature, and other factors of secondary importance. With any given group of occupants and type of air conditioner the intensity of body odor perceived upon entering a room from relatively clean air has been found to vary inversely with the logarithm of outdoor air supply and the logarithm of the air space allowed per person.

The minimum outdoor air supply necessary to remove objectionable body odors under various conditions, as determined experimentally at the *Harvard School of Public Health*³, is given in Table 1. Outdoor air requirements for the removal of objectionable tobacco smoke odors have yet to be determined. Practical values in the field vary from 10 to 15 cfm per person; this air quantity may and should be a part of that necessary for other requirements, e.g., removal of body odors, heat, moisture, etc.

The total quantity of air to be circulated through an enclosure is governed largely by the needs for controlling temperature and air distribution when either heating or cooling is required. The factors which determine total air quantity include the type and nature of the building, locality, climate, height of rooms, floor area, window area, extent of occupancy, and last but not least, the method of distribution.

It will be noted that, with adequate air space, the rate of air change indicated in Table 1 is from 10 to 30 cfm per person. In rooms occupied by only a few persons such a rate of air change will be automatically attained in cold weather by normal leakage around doors and windows while it can easily be secured in warm weather by the opening of windows. With a space allotment of 400 cu ft per person, only $1\frac{1}{2}$ air changes per

³Loc. Cit. Note 2.

hour are necessary to provide an air change of 10 cfm per person. This space allotment is essential for other reasons. It is indicated by the space requirements of ordinary furniture with room to move about between, and it is about the space needed in a two-bed sleeping room to avoid mouth spray infection.

Therefore, in the ordinary dwelling with adequate cubic space allotment, no special provision for controlling chemical purity of the air is necessary (aside from removal of fumes from heating appliances). With such conditions, the control of heat loss from the body is the major

TABLE 1. MINIMUM OUTDOOR AIR REQUIREMENTS TO REMOVE OBJECTIONABLE BODY ODORS
(Provisional values subject to revision upon completion of work)

TYPE OF OCCUPANTS	AIR SPACE PER PERSON CU FT	OUTDOOR AIR SUPPLY CFM PER PERSON
<i>Heating season with or without recirculation. Air not conditioned.</i>		
Sedentary adults of average socio-economic status.....	100	25
Sedentary adults of average socio-economic status.....	200	16
Sedentary adults of average socio-economic status.....	300	12
Sedentary adults of average socio-economic status.....	500	7
Laborers.....	200	23
Grade school children of average class.....	100	29
Grade school children of average class.....	200	21
Grade school children of average class.....	300	17
Grade school children of average class.....	500	11
Grade school children of poor class.....	200	38
Grade school children of better class.....	200	18
Grade school children of best class.....	100	22
<i>Heating season. Air humidified by means of centrifugal humidifier. Water atomization rate 8 to 10 gph. Total air circulation 30 cfm per person.</i>		
Sedentary Adults.....	200	12
<i>Summer season. Air cooled and dehumidified by means of a spray dehumidifier. Spray water changed daily. Total air circulation 30 cfm per person.</i>		
Sedentary Adults.....	200	<4

factor to be considered. The air breathed in the dwelling rarely contains chemical impurities; but the air which bathes the skin may often be too hot or too cold.

In more crowded rooms (large offices, large workrooms, auditoriums), the whole picture changes. Cubic space per person is less and the size of the room makes it impossible to admit untempered outside air without drafts. Here, mechanical ventilation is essential, but as will be noted in a later paragraph, it is even more essential for thermal than for chemical reasons. It is the removal of the heat produced by human bodies, rather than dilution of chemical poisons, which must govern practice.